

WHAT IS CLAIMED IS:

1. An antenna unit installed on a roadside portion of a lane where a processing regarding use of a toll road is performed for a vehicle passing through the toll road, the antenna unit comprising:

an antenna retaining portion retaining in a tip portion thereof an antenna coil configured to perform wireless communication with an IC card through an electromagnetic coupling; and

10 a drive mechanism configured to freely move said antenna retaining portion backward and forward between a position where said antenna retaining portion protrudes above the lane and a position where said antenna retaining portion is retracted in said unit.

2. An antenna unit as set forth in claim 1, further comprising:

a sensor configured to sense that the tip portion of said antenna retaining portion comes in contact with or approaches the vehicle; and

20 a control unit configured to control said drive mechanism to stop movement of said antenna retaining portion when a contact with or an approach to the vehicle is sensed by said sensor while said antenna retaining portion is moved by said drive mechanism from the retracted position in said unit to the protruding position above the lane.

25 3. An antenna unit as set forth in claim 1,

wherein said antenna retaining portion are further separable into an antenna head portion equipped with the antenna coil and a support portion supporting the antenna head portion on a tip thereof;

and

wherein the antenna head portion is mounted to be removable from the support portion by a push from a vehicle traveling direction on the lane.

5 4. An antenna unit as set forth in claim 1,
 wherein said antenna retaining portion retains two antenna coils in the tip portion thereof; and

 wherein the two antenna coils are respectively wound along a substantially vertical surface, and vertically aligned and
10 arranged in proximity to each other in the tip portion of said antenna retaining portion.

 5. An antenna unit as set forth in claim 1,
 wherein said antenna retaining portion comprises on the tip portion thereof:

15 two first antenna coils wound respectively along a substantially horizontal surface and arranged separately and opposite to each other; and

 a second antenna coil arranged to cover substantially one side of a space between the two first antenna coils and to be wound
20 along a substantially vertical surface.

 6. An antenna unit as set forth in claim 1,
 wherein said antenna unit comprises a plurality of said antenna retaining portions; and

 wherein each of said plural antenna retaining portions moves
25 independently forward and backward between the position where said antenna retaining portion protrudes above the lane and the position in said unit.

 7. An antenna unit as set forth in claim 6, further

comprising:

a plurality of transmitters and receivers configured to perform transmission/reception of signals separately using the antenna coil of each of said plural antenna retaining portions; and

5 a communication control unit configured to measure each electromagnetic field intensity or reception intensity based on received signals from each of said receivers and select one combination of said transmitter and said receiver to actively function.

10 8. An antenna unit as set forth in claim 6, further comprising:

a plurality of transmitters and receivers configured to perform transmission/reception of signals separately using the antenna coil of each of said plural antenna retaining portions; and

15 a communication control unit configured to time-divisionally process communication using respective combinations of said transmitters and said receivers and activate one combination of said transmitter and said receiver to which a link is made first.

20 9. An antenna unit as set forth in claim 6, further comprising:

a plurality of transmitters and receivers configured to perform transmission/reception of signals separately using the antenna coil of each of said plural antenna retaining portions; and

25 a communication control unit configured to time-divisionally process communication using respective combinations of said transmitters and said receivers to activate one combination of said transmitter and said receiver to which a link is made first, and measure each electromagnetic field intensity or reception intensity

based on received signals from each of said receivers to successively switch to one combination of said transmitter and said receiver which are optimum.

10. A card processing system which performs a processing
5 regarding use of a toll road for a vehicle passing through the toll road, the card processing system comprising:

an antenna unit which has an antenna retaining portion retaining in a tip portion thereof an antenna coil configured to perform wireless communication with an IC card through an
10 electromagnetic coupling, and a drive mechanism configured to freely move said antenna retaining portion backward and forward between a position where said antenna retaining portion protrudes above the lane and a position where said antenna retaining portion is retracted in said unit;

15 a vehicle stop detecting unit configured to detect a stopping of a vehicle on the lane; and

a control unit configured to control said drive mechanism of said antenna unit so that said antenna retaining portion protrudes above the lane when said vehicle stop detecting unit detects the
20 stopping of the vehicle on the lane.

11. A card processing system as set forth in claim 10, wherein said vehicle stop detecting unit comprises:

an image pickup device configured to pick up an image of the lane; and

25 a sensing unit configured to sense existence of the vehicle on the lane, and

wherein said control unit controls said drive mechanism of said antenna unit so that said antenna retaining portion protrudes

above the lane when a movement is not detected in an image picked up by said image pickup device and said sensing unit senses the existence of the vehicle on the lane.

12. A card processing system as set forth in claim 10,
5 further comprising:

a card approach detecting unit configured to detect an approach of the IC card to a tip of said antenna retaining portion; and

a control unit configured to control said drive mechanism
10 of said antenna unit so that said antenna retaining portion protrudes above the lane when said card approach detecting unit detects the approach of the IC card to the tip of said antenna retaining portion.

13. A card processing system as set forth in claim 12,
wherein said card approach detecting unit further comprises:
15 an image pickup device configured to pick up an image between said antenna unit and the vehicle on the lane; and

a recognizing unit configured to recognize an extension of an arm from the vehicle as the approach of the IC card to the tip of said antenna retaining portion based on the image picked up by
20 said image pickup device.

14. A card processing system as set forth in claim 12,
wherein said card approach detecting unit is configured to detect a disturbance in a magnetic field formed by the antenna coils.

15. An antenna unit installed on a roadside portion of a
25 lane where a processing regarding use of a toll road is performed for a vehicle passing through the toll road, the antenna unit comprising:

an antenna portion which has a plurality of antenna coil

configured to perform wireless communication with an IC card through an electromagnetic coupling;

a transceiver configured to perform transmission/reception of signals separately using the antenna coil of said antenna portion;

5 and

a communication control unit configured to select one of said plurality of antenna coil to actively function based on received signals from said transceiver.

16. An antenna unit as set forth in claim 15,

10 wherein said communication control unit time-divisionally and successively drives said plurality of antenna coil and activates one of said plurality of antenna coil to which a link is made first.

17. An antenna unit as set forth in claim 15,

15 wherein said communication control unit time-divisionally and successively drives said plurality of antenna coil and activates one of said plurality of antenna coil to which a link is made first, and measures each electromagnetic field intensity or reception intensity based on received signals from said transceiver and successively switch to one of said plurality of antenna coil which
20 are optimum.

18. An antenna unit as set forth in claim 15, the antenna unit further comprises a suspension control unit configured to stop driving said antenna coil which is not selected.